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ABSTRACT

This paper reports on a small scale evaluation study of a staff development project for high school mathematics teachers that focused on new curriculum, updating pedagogy, and examining issues of equity. After 2 years of the project, interviews were conducted with five previous participants who had varying amounts of staff development. Interview data were compared and supported by classroom coaching visits and teacher responses to an Instructional Practices Scale. Although all teachers could provide the rationale for "algebra for all," there were significant differences in the changes they had made in their classroom instruction that were related to the number of years of staff development in which they had been engaged. This study confirms that real change comes slowly with in-depth involvement in staff development over a long period of time. (Author)

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Joanne Rossi Becker, Barbara J. Pence and Dianne Pors

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BUILDING BRIDGES TO MATHEMATICS FOR ALL: A SMALL SCALE EVALUATION STUDY

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This paper reports on a small scale evaluation study of a staff development project for high school mathematics teachers that focussed on new curriculum, updating pedagogy, and examining issues of equity. After two years of the project, interviews were conducted with five previous participants who have had varying amounts of staff development. Interview data were compared and supported by classroom coaching visits and teacher responses to an Instructional Practices Scale. Although all teachers could provide the rationale for "algebra for all," there were significant differences in the changes they had made in their classroom instruction that were related to the number of years of staff development in which they had been engaged. This study confirms that real change comes slowly with in-depth involvement in staff development over a long period of time.

For a number of years we have been engaged in research in inservice education for secondary teachers focussing on teachers' beliefs, their relationship to classroom practices, and how changes in one may foster concomitant changes in the other (Becker & Pence, 1990a; 1990b; Peluso, Becker & Pence, 1994). As Grouws (1988) pointed out, there is little information available about the overall design features of inservice education which maximize changes in teacher beliefs and classroom behavior. Grouws has called for studies which focus on the impact of various features of inservice education on classroom practice. This paper extends previous work to add to the body of knowledge on inservice education.

The Program

The staff development program is now in its third year, and includes several facets (see Peluso, et al., 1994 for more details about the program). In addition to a 13-day intensive summer institute, the project includes classroom coaching, five followup workshops during the academic year, and purchase of manipulative materials, software and graphing calculators for the schools. Administered in conjunction with the College Board's Equity 2000 project, "Building Bridges" was designed to provide all high school mathematics teachers in two districts with basic staff development to focus on: equity in mathematics; innovative curriculum materials; use of technology; and new modes of pedagogy. This program was created to help teachers meet the challenge of eliminating tracking and placing all ninth grade students in algebra 1/course 1 by Fall 1995 as mandated by the Equity 2000 project.

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Goals of this Study

In this study we were interested in ascertaining which aspects of the "Building Bridges" program had the most impact on teachers; whether the program was able to facilitate change in teachers' beliefs about the teaching and learning of mathematics; and why some teachers from this project chose to continue into a two- or three-year project.

Methodology

The main source of data collection was in-depth interviews with the subjects. The five subjects were selected according to several criteria. First, we wanted to have a diversity amongst the teachers that was representative of the teachers we had in the project over the first two years. Second, we wanted teachers who had only participated in the "Building Bridges" project as well as others who had chosen to apply for the National Science Foundation project (NSF) which provides a continuation of the "Building Bridges" project. Potential interviewees were identified according to these criteria, their responses on the Instructional Practices Scale (Becker & Pence, 1990a), and experiences of staff during classroom coaching. An attempt was made to select teachers who exhibited a range of change in their teaching based on these criteria.

The interview questions probed goals of the project as teachers perceived them; difficulties their schools were experiencing implementing Equity 2000 goals; measures their schools were taking to alleviate the difficulties; what a typical mathematics class of the subject was like; a description of a rewarding lesson; their perceptions of their role as mathematics teachers; their beliefs about teaching and learning mathematics and how that has changed; the role of technology in teaching mathematics; the most and least useful aspects of the program; and, for those teachers who joined the NSF project, why they did so and what they hoped to gain from it in the next year.

Subjects

Five teachers were interviewed for this study. This included four female and one male teacher; one African American, one Vietnamese American, and three European Americans; and one non-NSF teacher, two who joined NSF for three years, and two who joined NSF for two years. Two of the teachers, Aretha and Kim, have about five years teaching experience; two, Kathy and Belinda, have approximately 15 years experience; and the fifth teacher, Brandon, has 25 years teaching experience.

Analysis

The interviews were audiotaped and transcribed fully. Responses were analyzed for patterns in responses within and across questions. Results were also triangulated using qualitative information from classroom coaching visits and quantitative data on the Instructional Practices Scale. Due to space limitations results

from the interviews which were confirmed by other data will be the focus of the discussion.

Results

Several components were highlighted as having an impact on participants. The paper will examine each of these components through the statements of the interviewees.

Equity 2000 Goals. All of the participants seemed to glean from the staff development the goals of the project and rationale for putting all ninth grade students in algebra 1/course 1. There also seemed to be agreement that these were worthy goals.

> Brandon: My understanding is, as presented in a workshop ...is that one, ... there had been a study... that students who at least go through geometry in high school had a better chance of getting into college and succeeding. And one of the primary goals was to make sure that students had exposure, that they would start off in algebra 1... but at least through geometry so they would have a fighting chance...So that was the primary goal of Equity 2000 to get students into algebra and make algebra accessible to students, particularly those who had been knocked out previously.

Typical Mathematics Class. There were some marked differences in the "typical" mathematics class of teachers who had been involved in staff development, through our "Building Bridges" and NSF programs, for one, two or three years. In this sample, Brandon had one year of staff development, Karen and Aretha had two years, and Belinda and Kim had three years.

Brandon described a fairly traditional class as his typical day.

> Brandon: In a typical day, say it's inequalities and equations, is to give them a wide range of examples....I would do so many, because I engage them from the beginning, I would do so many and they would do so many primarily on the board ... and then have at least 15 minutes for them to work on homework in class.

Contrast that to what Aretha and Belinda say; both are making much more use of cooperative groups and Belinda is actually using two different innovative curriculum materials, one for algebra and another one for geometry.

> Aretha: To begin my class I have a warmup question, one or two.... take 10 minutes for the warmup.... That's just a problem from yesterday, you know typical problems, a little review before I go on. And how I organize my classroom we work in groups all the time, all the time, except for the days we have tests.

However, Aretha still does some "traditional" teaching as well as group work, spending about 15 minutes of each class providing explanations before the group work.

Belinda has moved much further away from a traditional style of teaching, using College Prep Math for her geometry course and Computer Intensive Algebra for algebra 1.

> Belinda: Ok. In geometry I'm teaching the CPM Davis geometry, year two, and it's all group work. Kids are in groups of four. I place them in the groups... In the algebra 1 I do some lecturing as well as going around helping the kids on the computers. In the geometry I circulate around the room and I listen and I make sure that everybody in the group has the same question before I'll answer the question.

Role of the Teacher. The question of whether the program was able to facilitate change in teachers' beliefs about the teaching and learning of mathematics may be the most interesting result. Changes in teachers' beliefs proceed slowly. This study involved individuals who had varying years of institute participation. The change process can be seen as evolving as we look across the one, two, and three year experiences. For the person who has been involved for only one year, there is an awareness of suggested changes but little acceptance. The responses include references to what "they" say versus what "I" think.

> Brandon: One thing I'm finding more of is that they want me, when I say they I guess the powers to be have decided how it ought to be done, more of a facilitator than someone just delivering information. I don't have a problem with that as long as we understand that I think some days need to be different.

Aretha and Karen both spoke about struggling. Although they were both relatively new teachers and said that they had not changed because they had encountered similar ideas in their teacher education program, they were experimenting. This means that they were still maintaining a traditional classroom structure but they were trying various modifications in both curriculum and classroom organization. Even more important, they were reflecting on these experiments and their own transitions. At this point, they may have more questions than answers. The questions deal with their role as the classroom teacher, their curriculum, and the organization of their classroom.

> Karen: When I went to college the ideas as far as the changes in teacher's role were taught to me and I started teaching with that idea. But I think I got a better idea by going to the summer institutes . . . I still do lecture, but I do have portions of it where they're working and I'm trying to help them. It's really changed my view in so many things -- is there really a vital thing that I have to be teaching any more?

Kim and Belinda, however, have moved to more action-oriented thinking regarding their students and their role with other faculty.

> Belinda: It [staff development] has reoriented me to a new way of teaching...And it involves the kids more because they are more active in the learning...I just think the more involved they are the more

they'll learn. Obviously it has affected me a lot because I changed from a lecture teacher to a facilitator.

Use of Technology. All of the teachers found that the staff development had changed their views of the role of technology in teaching mathematics. But of course the longer staff development had allowed Aretha, Karen, Kim and Belinda to spend more time thinking about and using that technology. As a result they seem more willing to use technology, especially calculators, in algebra 1 as well as upper level classes, and have begun to question what exactly we should be teaching in light of the ready availability of technology. The project's ability to purchase graphing calculators for all schools over the three years has greatly facilitated teachers' incorporation of them into their teaching.

Brandon: But the graphing calculator, there's no two ways about it, it has opened up a whole new world. That has really changed.

Kim: Yeh the technology for me is, made me stop and think about what was really important to teach.

Most Useful Aspects of Program. Teachers seem to agree that the networking aspect of the project was one of the most important features to them. They feel they have little time during the academic year to meet with other teachers and learn from them, and the summer institute particularly provided that opportunity.

Kim: Well getting together with colleagues and talking was very important. Seeing their views and how they did things was really important because since I didn't have any previous experience with someone teaching me a certain way I had to see what other people who were taking risks were doing and seeing how they were doing it and trying it and going back. So that was real important.

Technology parts of the workshops were also very valuable although sometimes frustrating for teachers who had little or no access to computers.

Karen: Oh the most useful I would have to say all of the lessons we have had on the graphing calculator I have used quite a lot. In fact I discovered I actually know quite a lot about graphing calculators. And that's been really helpful.

Why the NSF Program. Finally we discussed with Aretha, Karen, Kim and Belinda, who had chosen to join the NSF program after completing "Building Bridges," why they had done so and what they hoped to gain from the next year of the project. Their positive experiences in the initial project stimulated their continuance; but perhaps more important, they felt the need for further professional growth and support as they tried to make curricular and instructional changes in their schools.

Karen: Well toward the end of the first summer I had really had a good time and I likened it to going to camp which I never got to do.... I just really enjoyed it. To be honest with you I, it was nice cause it was half the time that summer school was, I was going to be getting paid

for my time, and I knew that I was going to be leaving with a lot of good teaching things, and it satisfied professional growth for me. So really it did a lot of things for me.

For Aretha there was the added attraction of working on her own leadership skills.

Aretha: Ok. First time I see it, learn to become a leader, I say ok I need this skill because I'm so shy I don't speak for myself much at all. And I'm very very shy, I'm quiet. So I thought this is for me, I'll learn to speak for myself and maybe some day I'll get up there and do something. So that's why I tried it.

Kim in particular noted the importance of a support system provided by the network of teachers formed in these institutes.

Kim: I think that if I had not continued with NSF I probably would have just stopped and stayed where I was.... But with the continued programs and the support. And now what I'm seeing is this year at least we're all working on the same things, so we're starting to build the support in our schools.

Summary

This small-scale evaluation study substantiated what we and others (Clarke, 1994) have found previously: that short term staff development may have some impact on changing teachers' beliefs and practices, but that real change comes slowly with in-depth involvement over a longer period of time. Obviously the "Building Bridges" program had some effect on participants; even Brandon, who has perhaps not made a complete buy-in, has shown some change in use of technology and multiple representations in his teaching. He knows he should be working toward being more of a facilitator in class but the process of making that change seems difficult for him. For the other four teachers, there seemed to be a relationship between the length of inservice involvement and the extent of change in classroom instruction. All of these teachers seem to be on a journey toward implementing recommended reform in mathematics teaching; the more in-depth staff development we can provide, the more comprehensive that journey may be.

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